

RadNet Diagnostic/Self-Check Message

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RadNet Diagnostic/Self-Check Message

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Diagnostic/Self-Check Message Header

The Diagnostic/Self-Check message (Byte 3 of the RadNet header, code = 4) tells the instrument to perform a Diagnostic/Self-Check. The client software will send a standard RadNet Header Message to an individual instrument or broadcast to several instruments on a subnet. The client software must set the appropriate fields within the header, such as setting byte 3 to a value of 4.

The instrument/PC/Interface Hardware/ Translation Protocol Converter (*TPC) must be capable of handling the RadNet Diagnostic/Self-Check message. This can be done using the following methods:

- a. The receiving computer/TPC translates the RadNet source check message into the instrument's native code and sends this code to the instrument. Such as a computer connected to instrument using RS-232/485. It is the responsibility of the receiving unit to complete the task outline below.
- b. The receiving unit sends the RadNet Message to the instrument and the instrument processes the RadNet message. This approach would require the instrument be capable of understanding RadNet messages in serial format. The instrument would only need to look at byte 3 of the message to tell with what type of message it has received. Such as a TPC connected to an instrument. The TPC received the RadNet message from the network, it then passes the datagram portion of the packet to the serial port. The TPC does no translations of its own and does not check what the data stream contains (it up to the instrument to provide this support), it would pass the data stream onto the connected RS-232/485 instrument. It is the responsibility of the instrument to complete the tasks outline below.
- c. The instrument does not support this option; in this case the receiving unit ignores the RadNet message. This may be done because of security reasons. The instrument would only push data onto the network because the end user does not want the instrument to accept any commands from the network. If this is done to meet security concerns, it maybe appropriate to remove the receive wire from the serial connection. This way you can be assure that no data can get to the instrument. Because the message is ignored, the device would not perform the tasks outlined below.

* A TPC is an embedded device that converts RS-232/485 to Ethernet or Wireless using TCP/IP or UDP/IP. Their purpose is to take a serial communication data stream and place it into the datagram section of the protocol (See TCP/IP or UDP/IP RFC for more information) and forward it across the network. They also are capable of receiving data streams from the network and passing the data to a RS-232/485 instrument. Some examples of these devices are the Aquila RadCom, Lantronic MSS-1, Eberline TPC, etc.

Upon receiving this command the instrument would perform a self-check or diagnostic check on itself. The instrument would only perform internal checks that it is capable of performing. RadNet does not specify what checks the instrument must perform or how this is accomplished. Individual instrument manufacturers are responsible for determining what internal checks the instrument capable of performing. It is also the responsibility of the instrument manufacturer to determine what constitutes a failure (with regards to a self-check/internal diagnostic). The self-test could range from simply checking the current status bits to checking the entire NV Ram and hard disk for errors.

Another option that a manufacturer could provide is: As the instrument encounters errors/problems, it could send out a message indicating the error/problem it found. Each individual manufacturer is responsible for providing this functionality. The error is indicated by setting the **HW/OP Status** codes in the **RadNet Header** to appropriate value.

Once this task is completed, the instrument will broadcast a standard RadNet (byte 3 value = 0) messages indicating that the instrument has passed or failed the internal check.

At no time is the instrument allowed to stop/discontinue pushing data at the normal/abnormal push rates. However, the instrument would indicate that the self-check is being performed by the instrument using the HW/OP status codes in the RadNet Header. When the instrument enters a self-check/diagnostic state, it will push a packet indicating (such as HW/OP codes = 13, 14, 24, 28, 55) this state change. Upon completing the check, the instrument will push a packet indicating (HW/OP codes = 41 or 42) that the task has

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been completed. If the instrument failed the check then the instrument will start pushing data at the abnormal push rate and use the appropriate code to indicate the failure(s). If the instrument passes the check, then it will return to the previous push rate and status codes.

CAUTION:

If the monitoring computer and/or the instrument uses the same port (such as 16367) to send or receive data at a high push rate (instrument .1 second push rate), then data loss can occur. A .1 second normal push rate only allows for a very small window of opportunity to gain access to the instrument. Most instruments are simple 8 or 16 bit processor-based, incapable of spawning threads to handle multiple requests from the network.

Subsequently the network will be impacted because of network error messages. The error message generated by the network will say “destination port unreachable”. This error message is saying that the port is being used at the same time access is being requested. The logical course of action would *seem* to be to increase the push /requests rates. This approach, however, will only increase the network problem and could even bring the network down. Instead, it is appropriate to decrease the push/request rate. Increasing or using very high push rates is only appropriate when full knowledge of the network/instrument capacity is known and its affects are understood.

It is important to remember that the major limiting factor for RadNet is finite value of network bandwidth. Every message and every computer/instrument has an effect on the network and its available bandwidth. Therefore, every user, every computer and every instrument must utilize the network effectively. If RadNet has its own network infrastructure (Intranet), then there is also total control over the network and bandwidth usage. However, if RadNet is running on top or within existing infrastructure and/or connecting to the Internet, then network usage becomes important. As the network usage (bandwidth usage) increases, so does the number of collisions on the network that can lead to a network failure. If the RadNet normal/abnormal push rate is once every 5/1 minute(s), then there is plenty of open space (time) for a request to get through to the instrument.

Just because data can be pushed at .1 second and the network can handle it, doesn't mean it should. The push rate of the data should be based upon the instrument having valid data, how smart the instrument is, and its affect on the network during an event. It is necessary to allow enough bandwidth so that all of the instrument(s) can push at the abnormal push rates with network bandwidth to spare (<= 50% of the network bandwidth). RadNet makes use of the fact that instruments have become smarter and can detect when and if they have a problem. This important fact should also be used to determine the push rate of an instrument. The RadNet system should be tuned (push rates adjusted) to make sure there is plenty of reserved network bandwidth for an event (all instruments go into abnormal push rates). This scenario should be tested before going into production.

One way to prevent the bandwidth problem is to use two UDP ports for the network interface. Instruments can use port 16367 to send data and 16368 to receive requests. The monitoring computer can use port 16367 to receive data and port 16368 to transmit commands or requests. This distribution allows the instruments to continue to push data at high rates and still be able to receive request at the same time.

Instrument manufacturers can support the two-port option by being able to set the send/receive port parameters. If both parameters are set to 16367, then the instrument can only use one UDP port send/receive data. However, if the send parameter is set to 16367 (send/push data port) and the receive port is set 16368 (listen port) the instrument then requires two parameters. For a more secure interface, the listen port should only allow a certain IP address to pass requests. The instrument should check the incoming request against its list of IP addresses (MAC addresses can also be used). If the requesting IP address is not on this IP list, then the instrument can ignore the request. This technique is called IP filtering and is a common practice in the network world. To secure the instrument further, the listen option should also be selectable. Selectable means that the instrument will not allow anyone to gain access (request or send commands) to it and will only transmit data to the network. This option is valuable to any instrument that is not behind a secure firewall.

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| Field Name | Type | Position | Codes | Notes |
|-----------------------|------|----------|---|---|
| Header Check Sum | Byte | 1 | | <p>The first byte (01, byte) is a check sum, to ensure the integrity of the header transmission. The check sum is the sum of bytes 2 through 3</p> <p>The vendor is responsible for determining how this value is to be used.</p> |
| RadNet Version Number | Byte | 2 | See RadNet Versions Page | <p>The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of the RadNet message.</p> <p>The receiving software is responsible for handling all received RadNet messages, although the most current version's functionality may not be provided.</p> |
| Message Codes | Byte | 3 | See RadNet Message Codes Page | <p>Byte (03) is the message code. The message code tells what type of RadNet message has been sent (status, check source, etc.).</p> <p>Value = 4, Self-Check/Diagnostic</p> |

Diagnostic/Self-Check Message Format

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Example of Diagnostic/Self-Check Message Format:

The following is an example of how a Diagnostic/Self-Check Message would work.

| RadNet Field | Start Byte Position | End Byte Position | Notes |
|-------------------------------|---------------------|-------------------|--|
| Start Of RadNet Header | | | |
| Header Check Sum | 1 | 1 | The check sum is calculated using byte 2 to 3. |
| RadNet Version | 2 | 2 | Value = 0 |
| Message Code | 3 | 3 | Value = 4, Self-Check/Diagnostic |
| End Of RadNet Header | | | |

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Authentication Status Codes

See the following pages for more information concerning RadNet Security Implementation:

[Background Information](#)
[RadNet Security Implementation](#)
[Authentication](#)
[Encryption](#)

These codes indicate whether a RadNet message has been authenticated (message fails signature verification). RadNet message(s) are directed to/at a RadNet Authentication Server (RAS) or other device. The RAS will authenticate the message and set byte 52 to indicate the status of the authentication process. The RAS server will then forward the message to clients on the network. It is important that the RAS server is secure and that the data leaving the RAS server is on a secure network (the message will not be tampered with after authenticated). It is also important to note that the RAS server does not strip the authentication keys from the message, and the authentication process could be done at any time, including storing the authentication signature within a database for future verification of the message.

The Authentication software/server will set this byte value to indicated message signature verification status.

| Code | Meaning | Notes |
|------|---------------------------------------|-------|
| 0 | Message is Ok | |
| >0 | Message fails signature verification. | |

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RadNet Channel Types

Below is a code for type of channel.

| Code | Meaning | Notes |
|------|-----------------------------|--|
| 0 | Alpha | |
| 1 | Beta | |
| 2 | Gamma | |
| 3 | Neutron | |
| 4 | Iodine | |
| 5 | Noble Gas | |
| 6 | Tritium | |
| 7 | Stack Flow | |
| 8 | Sample Flow | |
| 9 | Temperature | |
| 10 | Sample Pressure | |
| 11 | Leak rate | Primary to secondary, or containment building leak |
| 12 | Reactor power | Used for leak measurements |
| 13 | Beta + Gamma | The sum of the beta and gamma channels. |
| 14 | Latitude | |
| 15 | Longitude | |
| 16 | Altitude | |
| 17 | Humidity | |
| 18 | Wind Speed | |
| 19 | Wind Direction | |
| 20 | Alpha/Beta | |
| 21 | Pulse Height Analysis (PHA) | |
| 22 | Dust Particle | |
| 23 | Humidity | |
| 24 | Anemometer | |

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RadNet Monitor Type Codes

Bytes (54-55) are code for the instrument type.

| Code | Meaning | Notes |
|------|--------------------------------|--|
| 0 | Gamma Area Monitor | Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information. |
| 1 | Gamma Crit Monitor | Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information. |
| 2 | Neutron Area Monitor | Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information. |
| 3 | Neutron Crit Monitor | Uses the Area Monitor body and footer format. See Area Monitor Header, Body, Footer, and Notes for more information. |
| 4 | Alpha CAM | Uses the Alpha CAM body, Measurement Footer, Spectrum Footer. See Alpha CAM Header, Body, Measurement Footer, Spectrum Footer and Notes for more information. |
| 5 | Beta CAM | Uses the Beta Cam body and footer format. See Beta CAM Header, Body, Footer and Notes for more information. |
| 6 | PCM Monitor | Uses the PCM body and footer format. See PCM Header, Body, Footer and Notes for more information. |
| 7 | PCM Portal Monitor | Uses the PCM Body and Footer format. See Portal Header, Body, Footer and Notes for more information. |
| 8 | PING | Uses the PING Body and Footer format. See PING Header, Body, Footer and Notes for more information. |
| 9 | Glove Box Monitor/Hand Monitor | Uses The PCM Body and Footer format. See PCM Header, Body, Footer and Notes for more information. |

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| | | |
|----|----------------------------------|---|
| 10 | Hand And Foot Monitor | Uses The PCM Body and Footer format. See Hand and Foot Header, Body, Footer and Notes for more information. |
| 11 | Generic Sensor | Uses The Generic Sensor Body and Footer format. See Generic Sensor Header, Body, Footer and Notes for more information. |
| 12 | Electronic Reading Dissymmetry | See Header, ERD Body, ERD Footer, for more information. |
| 13 | Item Contamination Monitor (ICM) | Uses The ICM Body and Footer format. See Header, Body, Footer and Notes for more information. |
| 14 | Radiation Gateway Monitor | Uses The Radiation Gateway Body and Footer format. See Header, Body, Footer and Notes for more information. |
| 15 | Gamma Spectrum | Uses The Gamma Spectrum Body, Measurement, Spectrum, Status and Footer format. See Header, Body, Measurement, Spectrum, Status and Notes for more information. |
| 16 | Portable Instruments | Protocol Pending, in development by vendor |
| 17 | Meteorology Tower | Uses The Meteorology Tower Body and Footer format. See Header, Body, Measurement, Status, and Notes for more information. |
| 18 | Video | Uses The Video Body, Status and Footer format. See Header, Body, Footer, Status and Notes for more information. |
| 19 | Image | Protocol Pending, in development by vendor |
| 20 | Audio | Protocol Pending, in development by vendor |
| 21 | Security data tag/seal | Protocol Pending, in development by vendor |
| 22 | Tritium Air Monitor | Protocol Pending, in development by vendor |
| 23 | Dust Particle Monitor | Protocol Pending, in development by vendor |

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RadNet Message Codes

Byte (03) is the message code. The message code indicates what type of RadNet message has been sent (status, check source, etc.).

| Code | Meaning | Notes |
|-----------|--------------------------------|---|
| 0 | Normal/Standard RadNet Message | Message is pushed by the instrument and received by the clients. |
| 1 | Alarm Ack | Message is pushed by the clients and received by the instruments. See Alarm Acknowledge Alarm Msg. Notes and Alarm Acknowledge Header Format |
| 2 | Pass Through | Message is pushed by the instrument and received by the client or can be pushed by the client and received by the instrument. This method can be used for bi-directional communication by the clients and instruments. See Pass Through Msg. Header Notes / Pass Through Header Format or Pass Through Codes |
| 3 | Check Source | Message is pushed by the clients and received by the instruments. See Check Source Msg. Notes and Check Source Header Format |
| 4 | Diagnostic/Self-Check | Message is pushed by the clients and received by the instruments. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format |
| 5 | Request Data | A client/server sends this request to an instrument. In response to this request the instrument will send its current information (Normal RadNet Message). See Request Data Notes and Request Data Header Format |
| 6 | Update/Request Date/Time | A client/server sends this request to an instrument. In response to this request the instrument will send/set the date/time. See Update/Request Date/Time Notes and Update/Request Date/Time Header Format |
| 7 | Acknowledge Receipt | This message is used by the monitoring computer to acknowledge receipt of data from an instrument. See Acknowledge Receipt Message Header Format and Acknowledge Receipt Message Notes for more information. |
| 255 (FFh) | Encrypted RadNet Message | See the following pages for more information: Background Information RadNet Implementation |

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| | | |
|--|--|---|
| | | Encryption Header Message Format Encryption Background Information |
|--|--|---|

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RadNet Operational and Hardware Status Codes

Note: It is the responsibility of the instrument manufacturer to prioritize the operational and hardware status for the instrument. Any status code can be used either as an operational or hardware status code base upon the instrument usage or needs.

Below is a code used to display the Hardware/Operational Status of the instrument. Hardware status is intended to be a troubleshooting guide when responding to an abnormal condition. Instrument hardware malfunctions generally require repair work. Other conditions may be attributed to either hardware or operational problems. Instrument vendors are responsible for classifying conditions and prioritizing the status change. The intention is that only the most critical status change be pushed; however a series of messages based upon a list of status changes could also be pushed. For example: If the instrument detected failures with low voltage and low background, the vendor could push each status in a separate message (at the abnormal push rate). These statuses could then be interpreted by the client as an HV power supply failure.

OP = Guide For Operational Status Use

HW = Guide For Hardware Status Use

| Code | Meaning | OP | HW | Notes |
|------|--------------------------------|----|----|-------|
| 0 | Normal | Y | Y | |
| 1 | High Alarm | Y | N | |
| 2 | HV Fail | N | Y | |
| 3 | Count Fail | Y | N | |
| 4 | Bkg Fail | Y | N | |
| 5 | Bkg Update | Y | N | |
| 6 | Comm Fail | N | Y | |
| 7 | Gas Empty | Y | N | |
| 8 | Buffer Full | Y | Y | |
| 9 | Acked High Alarm | Y | N | |
| 10 | Flow Fail Low | Y | Y | |
| 11 | Flow Fail High | Y | Y | |
| 12 | Filter Door Open | Y | N | |
| 13 | Instrument Not Ready | Y | Y | |
| 14 | Instrument In Calibration Mode | Y | Y | |
| 15 | Fast Concentration Alarm | Y | N | |
| 16 | Slow Concentration Alarm | Y | N | |
| 17 | DAC Hours Alarm | Y | N | |

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| | | | | |
|----|--|---|---|--|
| 18 | Count Rate Alarm | Y | Y | |
| 19 | Release Rate Alarm | Y | N | |
| 20 | Fast Concentration Alarm Disabled | Y | N | |
| 21 | Slow Concentration Alarm Disabled | Y | N | |
| 22 | Count Rate Alarm Disabled | Y | N | |
| 23 | Check Source Mode | Y | N | |
| 24 | Out Of Service | Y | Y | |
| 25 | Alert Alarm | Y | N | |
| 26 | Trend Alarm | Y | N | |
| 27 | Not Initialized | Y | Y | |
| 28 | Standby | Y | Y | |
| 29 | Local Control | Y | Y | |
| 30 | Flush | Y | N | |
| 31 | Alarm Disabled | Y | N | |
| 32 | External Fail | Y | Y | |
| 33 | AC Off | Y | Y | |
| 34 | Crit Relay Fail | Y | Y | |
| 35 | Out Of Limits | Y | Y | |
| 36 | Crit Alarm | Y | N | |
| 37 | NV RAM Fail | N | Y | When the instrument's non-volatile RAM cannot be read/written. |
| 38 | Check Source Results | N | Y | Indicates that the message with this status carries check source results. This indicates that this message contains the final check source result at the completion of the check source integration. Prior to this code being sent the status code would be 23 (<i>Check Source Mode</i>). |
| 39 | Audio Failure | N | Y | Indicates that the instrument has a problem with its audio circuit. |
| 40 | Over Range | Y | Y | Indicates that the instrument has exceeded an Over Range value. |
| 41 | Diagnostic/Self-check completed, Passed self-check | Y | Y | Indicates that the instrument has performed an Internal Diagnostic/Self-check and found no error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format |

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| | | | | |
|----|--|---|---|---|
| 42 | Diagnostic/Self-check completed, Failed self-check | Y | Y | Indicates that the instrument has performed an Internal Diagnostic/Self-check and found error conditions. See Diagnostic/Self-Check Msg. Notes and Diagnostic/Self-Check Header Format |
| 43 | High/High Alarm | Y | N | Third alarm level used in many plants. |
| 44 | Internal stabilization failure | Y | N | From automatic energy stabilization. |
| 45 | Parameter error | Y | N | Bad setup. |
| 46 | Temperature failure | N | Y | Temperature out of operational range. |
| 47 | Power supply failure | N | Y | From power supply, or from voltage reading. |
| 48 | Analog input failure | N | Y | 4-20 mA analog input failure (0 mA for example). |
| 49 | Filter failure | N | Y | Automatic filter advance failure (motor, end of roll...). |
| 50 | Detector cable failure | N | Y | |
| 51 | Electronic or Acquisition board failure | N | Y | Electronic failure. |
| 52 | Low Battery | N | Y | Backup battery or internal battery has a low voltage condition. |
| 53 | Battery Failed | N | Y | Backup battery or internal battery has failed. |
| 54 | Clock Failed | N | Y | Internal clock has failed. |
| 55 | User defined | Y | Y | This error code is used whenever an instrument supports user defined error codes. It is used whenever there is a desire to inform a user that one of their error conditions has been reached. Since there is no way of knowing what is contained in the error code logic, this generic response should be used to indicate the error. |
| 56 | Internal Communication Failure | N | Y | |

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RadNet Versions

Note: The last approved version in this list is the current version in use by RadNet.

The second byte (02, byte) is the RadNet version number. This number is used to indicate the version of RadNet be pushed by the server. It is the responsibility of the receiving software to handle all received RadNet messages, although the most current version's functionality may not be provided.

| Version | Date Approved | Notes |
|---------|---------------|-------|
| 0 | Approved | |

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RadNet Units Codes

Below is a code for the RadNet units of the reading.

| Code | Meaning | Notes |
|------|------------------------|--------------------------------|
| 0 | cps | |
| 1 | Rem/hr | |
| 2 | R/hr | |
| 3 | Sv/hr | |
| 4 | Bq/cm3 | |
| 5 | Bq | |
| 6 | Degrees Centigrade (C) | Temperature Unit |
| 7 | Pascal (Pa) | Pressure Unit |
| 8 | cc | Flow Volume Unit |
| 9 | cc/sec | Flow Rate Unit |
| 10 | cps/cc | Activity Unit |
| 11 | counts | Counting Events Unit |
| 12 | cm/sec | Velocity Unit |
| 13 | bqMeV/cc | Gamma Gas Activity |
| 14 | degrees | Wind Direction (180 = south) |
| 15 | Gy/hr | Dose Rate Unit |
| 16 | RPU% | Reactor Power Unit |
| 17 | Kg/sec | Masse flow rate |
| 18 | n/cm2 | Neutrons / cm2 |
| 19 | n/cm3 | Neutrons / cm3 |
| 20 | DAC | Derived Air Concentration |
| 21 | bq/m3 | Becquerel per cubic meter |
| 22 | bq/kg | Becquerel per kilogram |
| 23 | Latitude | |
| 24 | Longitude | |
| 25 | Mu_Hemin | Hemisphere North |
| 26 | Mu_Hemis | Hemisphere South |
| 27 | Mu_Hemie | Hemisphere East |
| 28 | Mu_Hemiw | Hemisphere West |
| 29 | Mu_Knots | Wind Speed (knots) |
| 30 | Mu_KPH | Wind Speed (knots per hour) |
| 31 | Mu_MPS | Wind Speed (meters per second) |
| 32 | Mu MPH | Wind Speed (meters per hour) |

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| | | |
|----|------------|-----------------------|
| 33 | Mu_METERS | Altitude (meters) |
| 34 | Mu_Feet | Altitude (feet) |
| 35 | Mu_Percent | Humidity |
| 36 | Resistance | Electrical Resistance |
| 37 | um | Micro-meter |

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RadNet Server Status Codes

Byte (7) is a code that displays the status of the server. Codes are provided for normal as well as a variety of abnormal conditions. See Appendix A for Server Status message codes.

| Code | Meaning | Notes |
|------|--------------------------------|-------|
| 0 | Normal Operation | |
| 1 | Instrument Communication Error | |
| 2 | TCP Communication Error | |
| 3 | UDP Communication Error | |
| 4 | Hard Disk Full | |
| 5 | Password Fail | |
| 6 | Starting Up | |
| 7 | Shutting Down | |
| 8 | Program Error | |
| 9 | NetWork Access Granted | |
| 10 | NetWork Access Denied | |